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June 2001

Science 30

Grade 12 Diploma Examination

Alberta
LEARNING

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June 2001

Science 30

Grade 12 Diploma Examination

Description

Time: This examination was developed to be completed in 2.5 h; however, you may take an additional 0.5 h to complete the examination.

This is a **closed-book** examination consisting of

- 40 multiple-choice and 12 numerical-response questions of equal value, worth 65% of the examination
- 1 short-answer question and 2 long-answer questions, worth 35% of the examination

This examination contains sets of related questions.

A set of questions may contain multiple-choice and/or numerical-response and/or written-response questions.

A science data booklet is provided for your reference.

Note: *The perforated pages at the back of this booklet may be torn out and used for your rough work.* ***No marks*** *will be given for work done on the tear-out pages.*

Instructions

- You are expected to provide your own calculator. You may use any scientific calculator or a graphing calculator approved by Alberta Learning. **NEW**
- You are expected to have cleared your calculator of all information that is stored in the programmable or parametric memory. **NEW**
- Use only an HB pencil for the machine-scored answer sheet.
- Fill in the information required on the answer sheet and the examination booklet as directed by the presiding examiner.
- Read each question carefully.
- Consider all numbers used in the examination to be the result of a measurement or observation.
- When performing calculations, use the values of the constants provided in the data booklet. Do **not** use the values programmed in your calculator.
- If you wish to change an answer, erase **all** traces of your first answer.
- Do not fold the answer sheet.
- The presiding examiner will collect your answer sheet and examination booklet and send them to Alberta Learning.
- Now turn this page and read the detailed instructions for answering machine-scored and written-response questions.

Multiple Choice

- Decide which of the choices **best** completes the statement or answers the question.
- Locate that question number on the separate answer sheet provided and fill in the circle that corresponds to your choice.

Example

This examination is for the subject of

A. science
B. biology
C. physics
D. chemistry

Answer Sheet

● Ⓑ Ⓒ Ⓓ

Numerical Response

- Record your answer on the answer sheet provided by writing it in the boxes and then filling in the corresponding circles.
- If an answer is a value between 0 and 1 (e.g., 0.25), then be sure to record the 0 before the decimal place.
- **Enter the first digit of your answer in the left-hand box and leave any unused boxes blank.**

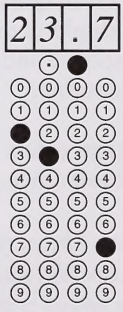
Examples

Calculation Question and Solution

The average of the values 21.0, 25.5, and 24.5 is _____.
(Record your **three-digit answer** in the numerical-response section on the answer sheet.)

Average = (21.0 + 25.5 + 24.5)/3
= 23.666
= 23.7 (rounded to three digits)

Record 23.7 on the answer sheet →



Correct-Order Question and Solution

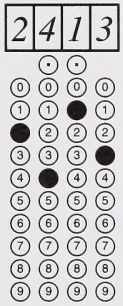
When the following subjects are arranged in alphabetical order, the order is ____, ____, ____, and ____ .

1 physics
2 biology
3 science
4 chemistry

(Record **all four digits** of your answer in the numerical-response section on the answer sheet.)

Answer: 2413

Record 2413 on the answer sheet →



Written Response

- Write your answers in the examination booklet as neatly as possible.
- For full marks, your answers must address **all** aspects of the question.
- Descriptions and/or explanations of concepts must be correct and include pertinent ideas, diagrams, calculations, and formulas.
- Your answers must be presented in a well-organized manner using complete sentences, correct units, and significant digits where appropriate.
- Relevant scientific, technological, and/or societal concepts and examples must be identified and made explicit.

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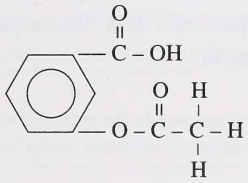
Disease may be caused by infectious agents or by genetic disorders. The body adapts to combat disease, but sometimes medical technology is used to help the body cope.

Use the following information to answer the first question.

Aspirin is used to help the body cope with pain and to prevent blood clotting.

Structural Formula of a Component of Aspirin



1. The functional groups present in the structural formula above are

   A. an alcohol and an ester
   B. a ketone and an alcohol
   C. an aldehyde and an alcohol
   D. a carboxylic acid and an ester

Use the following information to answer the next question.

Some Structures of the Circulatory System

1. Aorta
2. Lung capillaries
3. Left side of the heart
4. Right side of the heart

Numerical Response

1. Antibiotics are used to help the body fight infections. When an antibiotic is injected into a vein in a person's arm, the sequence in which it will travel through the structures listed above is _____, _____, _____, and _____.

(Record **all four digits** of your answer in the numerical-response section on the answer sheet.)

2. When an injection is given, bleeding may occur at the injection site. Blood clotting is initiated by

A. T cells
B. platelets
C. red blood cells
D. white blood cells

Use the following information to answer the next question.

Some Immune Responses

1. B cells produce antibodies.
2. Helper T cells identify markers.
3. Antibodies attach to foreign proteins.
4. Macrophages present antigen markers.

Numerical Response

2. When the human immune system is invaded by a particular virus for the first time, it responds by employing the immune responses listed above in the sequence _____ , _____ , _____ , and _____ .

(Record **all four digits** of your answer in the numerical-response section on the answer sheet.)

Use the following information to answer the next five questions.

> Tay-Sachs disease is an autosomal recessive disorder that attacks the central nervous system. In people with this disease, the accumulation of toxins in nerve cells results in the progressive destruction of central nervous system cells, which usually causes death by the age of four.

3. The central nervous system is composed of

A. the brain and spinal cord
B. sensory and motor neurons
C. the somatic and autonomic nervous systems
D. the sympathetic and parasympathetic nervous systems

4. Children with Tay-Sachs disease commonly become blind by the age of 18 months. The blindness is caused by damage to the

A. iris
B. lens
C. cornea
D. optic nerve

5. The genotype of a child with Tay-Sachs disease is

A. *tt*
B. *Tt*
C. *TT*
D. *TtTt*

6. A cross that could produce a child with Tay-Sachs disease is

A. $Tt \times Tt$
B. $Tt \times TT$
C. $TT \times Tt$
D. $TT \times TT$

Numerical Response

3. A baby is born to parents who are both carriers of Tay-Sachs disease. The probability that the baby will have the disease is _____%.

(Record your answer in the numerical-response section on the answer sheet.)

Short Answer—5%

AIDS is a disease caused by the human immunodeficiency virus (HIV). The HIV virus attacks and destroys helper T cells. Using your knowledge of how the components of the immune system interact, explain why HIV is a dangerous virus.

The energy industry has a major impact on Alberta's economy and environment.

7. Coal provides over 90% of Alberta's electrical energy needs. Coal is composed primarily of

A. esters
B. ketones
C. alcohols
D. hydrocarbons

Use the following information to answer the next question.

Anthracite coal in a coal-fired power plant burns according to the equation

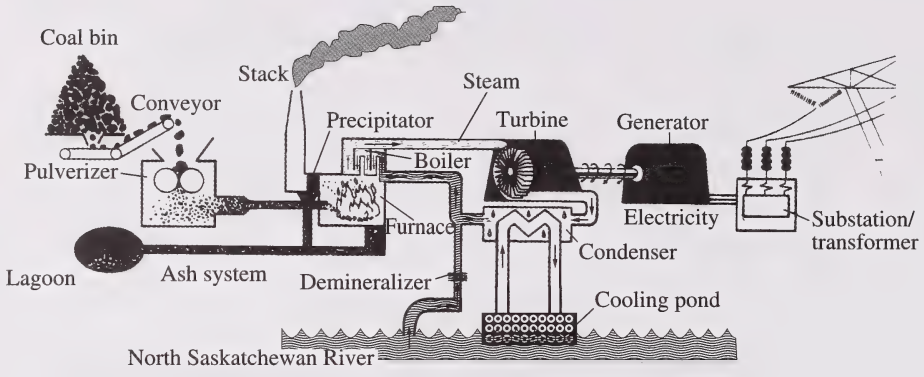
$$\text{Anthracite} + 55\tfrac{1}{2}\,O_{2(g)} \rightarrow 52\,CO_{2(g)} + 8\,H_2O_{(g)}$$

8. The heat of formation (ΔH_f°) of anthracite is –396.4 kJ/mol. The heat of reaction (ΔH) for the equation above is

A. -1.778×10^4 kJ
B. -1.857×10^4 kJ
C. -2.200×10^4 kJ
D. -2.279×10^4 kJ

Use the following diagram to answer the next five questions.

Diagram of a Coal-Fired Power Plant



Numerical Response

4. Sound waves are used to monitor the level of coal in bins. What is the wavelength of a sound wave that has a frequency of 255 Hz and travels at 340 m/s?

Answer: _____ **m**

(Record your **three-digit answer** in the numerical-response section on the answer sheet.)

9. In the plant depicted above, the conversion of mechanical energy to electrical energy occurs at the

A. boiler
B. turbine
C. generator
D. precipitator

10. Coal is pulverized into powder before it is blown into the furnace. The WHMIS symbol that would be found near the furnace in this area of the plant is

A.

B.

C.

D.

11. Starting with the energy in a lump of coal and ending with the energy output by the generator of the plant, the energy conversions listed in order, are

A. solar → thermal → chemical → electrical

B. solar → mechanical → thermal → electrical

C. chemical → electrical → mechanical → thermal

D. chemical → thermal → mechanical → electrical

Use the following additional information to answer the next question.

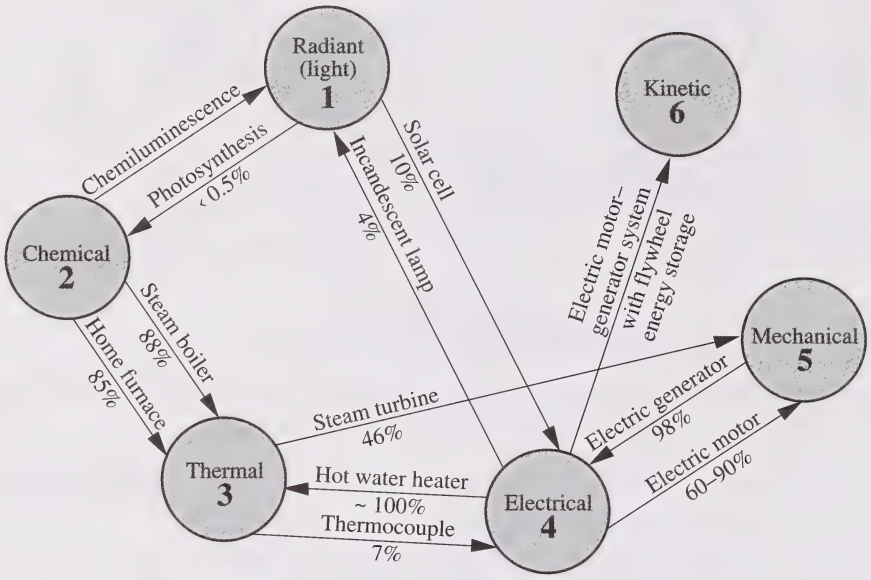
In a coal-fired power plant, heat is added at the ___*i*___, useful energy is removed at the ___*ii*___, and waste energy is removed at the ___*iii*___.

12. The statement above is completed by the words in row

	i	*ii*	*iii*
A.	turbine	cooling pond	boiler
B.	boiler	generator	cooling pond
C.	boiler	turbine	precipitator
D.	turbine	precipitator	generator

Use the following diagram to answer the next two questions.

Some Energy Types with Their Conversions and Efficiencies (%)



Numerical Response

5. The sun's energy is converted into the energy of a rotating turbine in a coal-fired power plant. Starting with the sun's energy, when the types of energy in this conversion are listed in the order in which they are converted, their order is _____, _____, _____, and _____.

(Record your **four-digit answer** in the numerical-response section on the answer sheet.)

13. The diagram illustrates that for each energy conversion some energy is lost. If 1 000 J of electrical energy (number 4 on the diagram) are converted to radiant energy (number 1 on the diagram) in an incandescent lamp, how much light energy is emitted?

A. 40 J

B. 100 J

C. 980 J

D. 1 000 J

14. DNA contains nitrogen bases. The correct pairing of the nitrogen bases in DNA is

A. guanine with uracil
B. guanine with adenine
C. adenine with thymine
D. cytosine with thymine

15. Which of the body's defence mechanisms provides the **first** protection against health hazards associated with coal dust?

A. Antibodies and platelets
B. Autonomic nervous system
C. Bodily secretions such as mucous
D. Stomach acid and digestive enzymes

16. At a coal-fired power plant, an operator accidentally touches a pipe carrying steam at 500°C. He pulls his hand away before he is aware of what is happening. His initial reaction is the result of a

A. reflex arc response
B. central nervous system response
C. sympathic nervous system response
D. parasympathetic nervous system response

17. When a safety alarm sounds suddenly, an operator's nervous system reacts by

A. increasing the activity level of the sympathetic nervous system and increasing the heart rate
B. decreasing the activity level of the sympathetic nervous system and decreasing the heart rate
C. increasing the activity level of the parasympathetic nervous system and increasing the heart rate
D. decreasing the activity level of the parasympathetic nervous system and decreasing the heart rate

18. Some coal-fired plants use cooling ponds in order to

A. decrease land usage
B. increase wildlife habitat
C. increase biomagnification in local habitats
D. decrease thermal pollution in local habitats

19. In some electrical power plants, the generator coils are cooled by hydrogen rather than air. An advantage of using hydrogen is that it has less wind resistance, but a disadvantage is that it is

A. explosive
B. a greenhouse gas
C. a cause of dioxin formation
D. able to biomagnify in the ecosystem

Numerical Response

6. At a power plant, the generator produces a voltage of 20.0 kV and a current of 130 A in the primary coil of a transformer. If the voltage is stepped up to 240 kV, the current in the secondary coil of the transformer will be _____ A.

(Record your **three-digit answer** in the numerical-response section on the answer sheet.)

20. High voltage is used for electricity transmission in order to

A. increase amperage
B. increase resistance
C. decrease power loss
D. decrease risk of electrocution

21. In a residential area, electrical power is stepped down from 100 000 V to 220 V. If the transformer that accomplishes this change has 25 000 turns on the primary coil, how many turns must it have on the secondary coil?

A. 55 turns

B. 880 turns

C. 5.5×10^4 turns

D. 8.8×10^7 turns

Numerical Response

7. If a generator produces 13.6 A at 19 000 V, how much power is produced?

Answer: _____ **x 10^5 W**

(Record your **three-digit answer** in the numerical-response section on the answer sheet.)

Although the production of electricity brings many benefits, it always has an environmental cost.

Use the following information to answer the next four questions.

Analysis of Water From a Lake Adjacent to a Power Plant

Water Quality Parameter	Reading
pH	5.00
BOD	25 μg/mL
Lead (Pb)	100 μg/mL
Temperature at the bottom of the lake	10°C

22. The water quality parameter that indicates the presence of a significant amount of living matter is the

A. low pH

B. high BOD

C. high temperature

D. high concentration of heavy metals

23. Since the lake water has a pH of 5.00, it must have a hydronium ion concentration, $[H_3O^+_{(aq)}]$, of

A. 5.0×10^{-1} mol/L

B. 1.0×10^{-5} mol/L

C. 5.0×10^{1} mol/L

D. 1.0×10^{5} mol/L

24. If the pH of the lake water is raised from 5.00 to 7.00 before it is used in a turbine, the hydronium ion concentration, $[H_3O^+_{(aq)}]$, must be decreased by a factor of

A. 2
B. 10
C. 100
D. 200

25. An indicator that could be used to show a pH change from 5.00 to 7.00 is

A. orange IV
B. methyl orange
C. phenolphthalein
D. chlorophenol red

Use the following information to answer the next question.

Some Forms of Pollution

1 CFCs
2 Thermal
3 Particulates
4 Acid deposition
5 Greenhouse gases
6 Phosphates

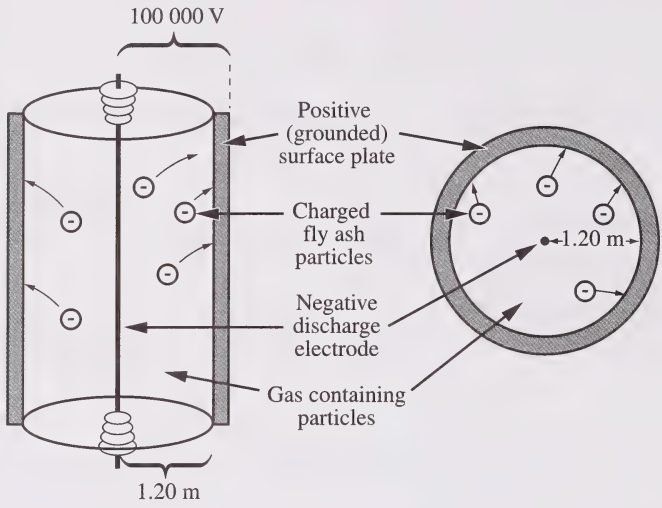
Numerical Response

8. The four forms of pollution listed above that are **most commonly associated** with a coal-fired power plant are _____, _____, _____, and _____.

(Record **all four digits** of your answer in the numerical-response section on the answer sheet.)

Use the following information to answer the next three questions.

The burning of coal dust produces gases and incompletely burned particles called fly ash. Fly ash contains traces of aluminum, potassium, silicon, and mercury. The fly ash is collected by means of an electrostatic precipitator. In the precipitator, an electrode charges the fly ash particles, which are then attracted to a grounded surface plate.



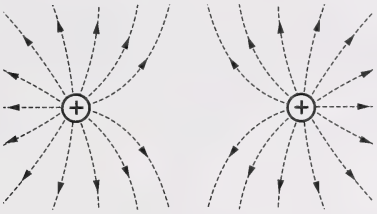
Numerical Response

9. The electric field strength between the negative discharge electrode and the surface plate is _____ $\times 10^4$ V/m.

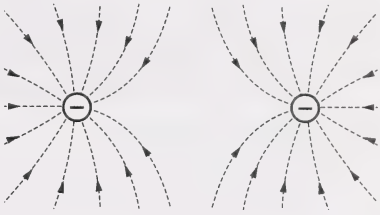
(Record your **three-digit answer** in the numerical-response section on the answer sheet.)

26. To prevent fly ash from being released into the environment, positively charged plates are used to filter the ash. This design calls for giving each particle of fly ash a negative charge. A diagram that represents the electric field between two negatively charged fly ash particles is

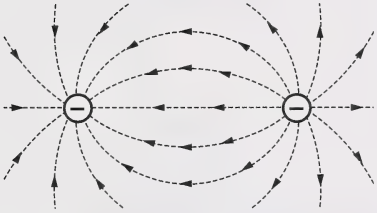
A.



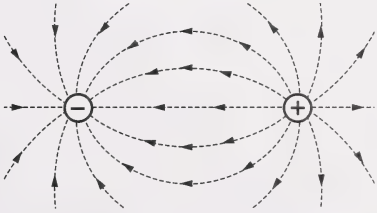
B.



C.



D.



27. A particular fly ash particle has an electric charge of 2.00×10^{-4} C. The electric field strength of this particle at 0.80 m from its centre is

A. 250 N/C

B. 2.2×10^{6} N/C

C. 2.8×10^{2} N/C

D. 2.8×10^{6} N/C

Use the following information to answer the next question.

Particles of fly ash are approximately 5×10^{-7} m in diameter. In the atmosphere, they reduce visibility, influence weather, and affect breathing.

28. Fly ash particles will interfere with the transmission of electromagnetic radiation if they are approximately the same diameter as the wavelength of the radiation. Therefore, fly ash particles would cause transmission problems with

A. X-rays
B. radio waves
C. gamma rays
D. visible light

Use the following information to answer the next two questions.

Mercury in fly ash is gathered and processed in ash lagoons where it is converted to dimethyl mercury by bacteria in the lagoon water.

29. Dimethyl mercury can pass through a food chain and accumulate in the fat of organisms in a process referred to as

A. photosynthesis
B. target specificity
C. biodegradability
D. biomagnification

30. Which of the following organisms living in or near the ash lagoon would **most likely** have the highest concentration of dimethyl mercury?

A. Algae
B. Pelicans
C. Minnows
D. Water insects

31. Fly ash may be used to treat acidic soils. The pH of the ash is likely

A. 3
B. 4
C. 6
D. 8

32. Compared with coal-fired power plants, nuclear power plants produce more

A. greenhouse gases
B. kilograms of waste
C. of Alberta's electricity
D. energy per gram of fuel

Use the following information to answer the next question.

Some Energy Conversions

1 Coal combustion
2 Uranium fission
3 Steam condensation

Numerical Response

10. When the energy conversions above are listed in order from the least amount of energy per mole they release to the greatest amount of energy per mole they release, their order is _____ , _____ , and _____ .
least **greatest**

(Record **all three digits** of your answer in the numerical-response section on the answer sheet.)

---

33. One of the initial decay products of radon-222 is polonium-218. The balanced equation for this decay of radon is

A. $^{222}_{86}\text{Rn} \rightarrow {}^{218}_{84}\text{Po} + {}^{4}_{2}\text{He}$

B. $^{222}_{86}\text{Ra} \rightarrow {}^{218}_{84}\text{Po} + {}^{4}_{2}\text{He}$

C. $^{222}_{86}\text{Ra} \rightarrow {}^{206}_{82}\text{Pb} + {}^{16}_{4}\text{Be} + \gamma$

D. $^{222}_{86}\text{Rn} \rightarrow {}^{206}_{82}\text{Pb} + {}^{16}_{4}\text{O} + 4\ {}^{0}_{-1}\text{e}$

The exploration of space allows scientists to monitor conditions on Earth and has resulted in the development of many technologies.

34. More ultraviolet radiation is able to reach Earth's surface now than in the past because of the

A. creation of the ozone layer in the upper atmosphere
B. thinning of the ozone layer in the upper atmosphere
C. reflection of radiation off the ozone layer into the lower atmosphere
D. amount of photochemical smog containing ozone in the lower atmosphere

35. Total internal reflection is a phenomenon that is used to send energy

A. by laser through the air
B. through a fibre-optic cable
C. between microwave towers
D. along a conducting wire as electricity

36. Analysis of radiation from space reveals information about the

A. reflection and refraction of light
B. composition, structure, and motion of stars
C. colours of elements at different temperatures
D. way that radio telescopes use computers to compile data

37. Because of Earth's atmosphere, telescopes based on Earth's surface are **restricted** to collecting **mainly**

A. radio waves and visible light
B. X-ray radiation and visible light
C. radio waves and X-ray radiation
D. X-ray radiation and ultraviolet radiation

38. When light is split into its component colours (wavelengths), the result is

A. a spectrum
B. white light
C. polarized light
D. total internal reflection

39. The **shift** in spectral lines for stars reveals that most stars

A. vary in size and temperature
B. are moving toward our solar system
C. are all the same size and temperature
D. are moving away from our solar system

Use the following information to answer the next two questions.

A satellite is located 6.47×10^6 m from the centre of Earth and has a mass of 980 kg.

Numerical Response

11. The gravitational force exerted on the satellite by Earth is _____ $\times 10^3$ N.

(Record your **three-digit answer** in the numerical-response section on the answer sheet.)

40. The strength of the gravitational field experienced by Earth **that is caused by the satellite** is

A. 9.51 N/kg
B. 9.81 N/kg
C. 1.01×10^{-14} N/kg
D. 1.56×10^{-21} N/kg

Use the following diagram to answer the next question.

Diagram of a Particular Alignment of Sun, Moon, and Earth

Numerical Response

12. The positions numbered above on Earth's surface listed in order from that with the lowest tide to that with the highest tide are _____ , _____ , _____ , and _____ .
lowest **highest**

(Record **all four digits** of your answer in the numerical-response section on the answer sheet.)

Long Answer—15%

1. A farmer who farms downwind from a sour gas plant wonders why his alfalfa crop has not been producing well in the last few years, whereas his potato crop continues to thrive.

Describe, in detail, a study that could be carried out to determine if the problem that the farmer is encountering is caused by acid deposition from the sour gas plant. Include tests that you might carry out on the plants, soil, and rainwater. Include one data table that could be used in your study.

Turn the page to begin the next question.

Long Answer—15%

2. Compare **one** method of producing electricity from list 1 below with **one** method from list 2. In your comparison, describe economic, environmental impact, and resource depletion issues related to the two methods you choose.

Some Methods of Producing Electricity

List 1	List 2
• Hydroelectric power	• Geothermal power
• Power from fossil fuels	• Wind power
• Nuclear power	• Tidal power
	• Biomass power
	• Solar power

You have now completed the examination.
If you have time, you may wish to check your answers.

No marks will be given for work done on this page.

Fold and tear along perforation.

No marks will be given for work done on this page.

Fold and tear along perforation.

Science 30

June 2001

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Science 30

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